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Digital Mapping, Charting, and Geodesy
Analysis Program (DMAP)
Technical Review of
Vector Data Update (VDU) Layer

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14. ABSTRACT

The Vector Data Update (VDU) is a standard digital Geospatial Information and Services (GI&S) product used by the National Imagery and Mapping Agency (NIMA) to transmit Digital Nautical Chart (DNC) data updates to Naval Operational Forces, including Navy ships at sea. This review, conducted by the Naval Digital Mapping, Charting, and Geodesy (MC&G) Analysis Program (DMAP) at Stennis Space Center, MS, examines the Draft Performance Specification for VDU Layer, dated 3 October 2002.

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1.0 Background

The Vector Data Update (VDU) is a standard digital Geospatial Information and Services (GI&S) product used by the National Imagery and Mapping Agency (NIMA) to transmit Digital Nautical Chart (DNC) data updates to Naval Operational Forces, including Navy ships at sea. This review, conducted by the Naval Digital Mapping, Charting & Geodesy (MC&G) Analysis Program (DMAP) at Stennis Space Center, MS, examines the Draft Performance Specification for VDU Layer, dated 3 October 2002.

VDU is designed to provide an update layer that can be distributed along with patch updates. A VDU layer is a Vector Product Format (VPF) coverage that can be added to the underlying VPF data set. It contains geospatial features and attribution that represent any changes made to a DNC data coverage, and identifies the sources of those changes.[1]

The update distributed by NIMA will provide a binary patch update with information for each VPF library. It is designed to flag and distribute additional information about significant changes made since the last database edition of the baseline product [e.g., DNC]. Typically this will include features that are significant for safety of navigation. It will contain information such as Notice to Mariners (NtM) number and accompanying text; current and previous feature IDs, as well as coverage and feature class information.[2]

2.0 Discussion

2.1 Binary Patch Methodology

The binary methodology for updating DNC offers a sound approach to minimizing the size and speed of data transmissions. Completing the update as a patch offers the added benefit that only the feature items with changes have to be modified, therefore reducing the time, effort and cost needed to upgrade potentially hundreds of product copies on the user platforms.

The binary update does incur a potentially negative aspect since it requires the user to copy all of an existing DNC CD-ROM to hard drive media prior to executing the patch. For some DNC users that already utilize a hard disk library of DNC data, this method will not impose added workload. However, for a substantial number of users that currently operate directly from the DNC CD-ROM media, this approach can increase their requirements for time, manpower and hard disk media. Although this report offers no alternative update methods, it is recommended that NIMA provide the user with estimates of both the hard disk space and processing time needed to complete the patch. This data could be included as analog information on the jacket to the distribution media, or could be delivered as a readme.txt file accompanying the patch download files.

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[1] NIMA Performance Specification, Vector Data Update (VDU) Layer, Section 3.3.
[2] NIMA Performance Specification, Vector Data Update (VDU) Layer, Section 3.7.
Manuscript approved November 18, 2002.

2.2 COTS Binary Patch

The choice of a COTS binary patch utility is economically efficient as it precludes the cost of government development and maintenance. However it does place the government in a position of future dependence upon a commercial vendor. In this particular situation this may not be critical since there are multiple vendors of binary patch utility software, but because of the frequent proprietary nature of commercial vendor code the use of a commercial vendor product may retard or prevent future innovation and advancement by other developers, either government or commercial.

2.3 Local User Update Generation Needed

With the binary patch method of update the local user is dependent on an outside agent to supply the change file. Notice to Mariners (NtM) is published weekly and monthly. It is assumed that initially NIMA will produce monthly updates based on the NtM. However, safety of navigation requires a more frequent update cycle. In addition to NtM warnings, hazards related to navigation and the US Coast Guard by means of marine radio transmissions frequently broadcast operational restrictions in US coastal waters. In order for these "near real time" warnings and weekly notice to marines to be shown on the chart, a local update capability is required by the navigator in addition to the binary patch distributed from NIMA. This is not to say that the binary patch is not a good idea, but only to indicated that all the needs of the navigator in maintaining his/her charts may not be met by a binary patch method and that a local update technique under the control of the navigator may be required.

2.4 Cumulative Update and UPD Coverage

VDU updates will be cumulative. That is to say that all previous patches will not need to be applied in order to bring the chart to currency by means of the last update patch. This is not a bad idea, but it will require that each subsequent patch will grow in size and transmission time. Perhaps it might be beneficial to offer two types of update files, one that is cumulative and another that is sequential. In this manner the user could minimize the transmission time if he did not require a cumulative patch.

Additionally, the UPD coverage that indicates the changes made since the last update is not cumulative. Thus a user applying the standard cumulative update will not be able to determine all the changes made since the original CD issue, but can only determine from the UDP the changes made in the last update cycle.

2.5 Compression

A data compression technique was tried on several binary patch files. This compression resulted in a 7% reduction in file size. This amount of reduction was not considered to be significant. However since the patch is specifically required to perform VPF updates it does suggest the possibility that a specialized compression strategy could be developed for the generation of the

patch. It is assumed that the present binary patch utility uses a compression algorithm suitable for generalized application.

2.6 One-way Transmission Error Rate

Ships are often required to maintain radio silence. Under this requirement it is assumed that updates would be transmitted by general area broadcast with the ship in receive only status. This could present a problem as a result of errors contained in the received patch. A binary patch is an efficient method of update, but it requires that the update patch be absolutely free of errors. An addition or loss of one byte will destroy the entire utility of the patch. With Internet distribution the user's system has the capability to check for packet errors during transmission and ask the sender to retransmit any packet in question. Under radio silence it is not possible for the user to ask for retries in this manner. If it is determined that updates will be required under these conditions then additional work will be required to improve redundancy and error correction techniques for the "one-way" broadcast of the binary update patch.

2.7 Inclusion of Text File that Indicates Changes

While a binary update is good for a computer, it really doesn't "read" well to the human. It might be beneficial to the user to be able to access a text file in a format similar to NtM that would allow him to quickly scan the changes for items of significance. This might prove to be a better way to alert the user of significant changes than requiring the user to do data base queries on the UPD Coverage. This is speculative, and in resolution will require actual experience by the users of the UPD to determine its effectiveness. Adding text would also significantly increase file size.

2.8 Update Validation

Consideration should be given to the current DNC validation process to insure that any changes provided in the binary update patch are included in this quality control cycle. Currently, all new edition DNC products are processed through validation software at NRL or NIMA to detect problems with cross tile topology and any possible conflicts between adjacent features. Under the methodology identified in the specification, updates issued by a binary update patch will not go through this validation process until a new edition DNC is issued. This could allow problems to go undetected until they reach the end user. A new method of checking only the features contained in the update patch before it is issued might insure that a clean product update is delivered to the operational forces that utilize this product

2.9 Identification of DNC Edition Number

Using the VDU to update existing DNC coverages based on the instructions offered in the README.txt and APPLY.txt files is somewhat ambiguous in that it doesn't clearly indicate the DNC Edition # that a particular VDU supports. Likewise, the labels on the VDU CD-ROM and its jewel case were also not supportive of communicating this information. Since the VDU is

specific to the latest version of a DNC product, NRL recommends that NIMA post the DNC and Edition # clearly on the CD-ROM and jewel case.

2.10 Test of the Patch Software on DNC17

NRL conducted tests of the VDU Edition 007 of Sep 02. The tests were conducted on two of the latest editions of the DNC 17 (e.g., ED 29 & 30) products. This gave NRL a look at what the end user would experience if the VDU were used properly on the latest DNC product, and what results would occur if a previous version were mistakenly utilized for the update. In general, the user experience was fairly simple and straightforward. The README.txt and APPLY.txt files offer a concise set of instructions to be followed by the user. The fact that the update patches are organized in accordance with the DNC Library structure does minimize the size of individual update files, but it also means that the user must execute a patch command sequence for each library file. This redundant process could be simplified with the use of a batch processing file that executed the 'patch' command for each of the update coverages contained within a DNC VDU.

Numerous libraries were tested for the DNC17ED30 and DNC17ED29 products. In each of the tests, the 'patch' command executed without any problems. All of a subset of DNC17ED30 executions was completed successfully without any error messages. These updates seem to execute properly by either replacing existing files with those that had updates or by adding new files where there were missing files. However, the DNC17ED29 runs created error messages that included: *"warning upt0036: Old File not found. However, a file of the same name was found. No update done since file contents do not match"*.

A good indicator of the effect incurred during the update process is the size and number of files stored with in a particular DNC17 library coverage. In example, prior to update, Library H1707470 contained 3.15 Mb (3,311,497 bytes) on disk. Once updated this file size increased to 3.16 Mb (3,315,478 bytes) on disk. 238 patches were executed with 217 files modified and 21 files being added. It is noted that the statistics presented in executing the 'patch' command are very useful to the user. However, the buffer size of the dialog comments presented in the Command Prompt window limited the amount of the history that could be viewed after executing the 'patch' command. It is recommended that NIMA add a text file output to this command to store the full results of the command process.

Also the UPD coverage presented in the DNC Library after update is very helpful. The inclusion of a text file containing the table listings for the UPD might be helpful in that it would allow the user to view a listing of the changes without having to open up additional software capable of viewing VPF coverages.

2.11 Editorial Notes

The following table shows the suggested editorial notes found during the review.

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Table 1. Editorial Notes for VDU Update Layer

Necessity	Page	Section	Comment
Suggested	4	3.3.1	Remove extra space after heading
Suggested	5	3.6.1 a	Change coverage to coverage
Suggested	12	Table 10	Add period to end of Note.
Suggested	13	Table 13	Add period to end of Note.

3.0 Conclusions

The binary update method chosen by NIMA for distribution of the VDU to DNC users offers a viable approach to executing VPF data updates at the user level. It can impose some requirements for additional hard disk and processing time, but overall is viewed as one of the most practical methods available to date for data library updates. The fact that the updates are cumulative also imposes some potential for the user to encounter significant demands on disk storage and time to process. It does, however, insure that the data content provided includes all existing changes to date and minimizes the effort required to implement any missed updates.

The production process of the binary update patch doesn't seem to include all of the steps currently taken to validate DNC data, namely the data may not pass through the VPF validation software at NRL or NIMA. Therefore, more consideration may be needed to insure that the feature content and structure of all data updates are verified in the same manner as the original DNC data product.

4.0 Recommendations

The following recommendations are offered to serve as an approach that might be beneficial to Naval applications of the DNC update patch methodology.

- *Binary Update Method -* NIMA should provide the user with estimates of the hard disk space, file copy time and execution time needed to complete the patch. This data could be included as analog information on the jacket to the distribution media, or delivered as a readme.txt file accompanying the patch download files.
- *VDU updates need to be both cumulative and sequential* –It is recommended that NIMA consider the benefits of offering two types of update files: 1) a cumulative file containing all previous updates and 2) a sequential file offering only the feature updates contained on a particular update patch.
- *Improving User Awareness of Updates* –NRL recommends that NIMA consider providing the user with an optional output text file in a format similar to NtM. It would offer a quick scan of any changes included in a particular binary update patch.
- **Local Update Capability -** A local update capability is recommended to provide the navigator with "near real time" warnings and weekly notice to mariners to be shown on the chart in addition to the binary patch distributed from NIMA.
- **Provide More Descriptive Information on CD-ROM Jewel -** Since the VDU is specific to the latest version of a DNC product, NRL recommends that NIMA post the

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